

An Introduction to E diesel®: Commercialization & Standardization

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**Representing the E diesel® Consortium
to the
“Alternative Diesel Symposium”**

**The California Air Resources Board
&
The California Energy Commission
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Diesel Market Overview

- Diesel emissions under global assault (public health, etc.)
- Global policies challenge OEMs, fleet operators, refiners and marketers
- Targeted emissions from diesel: NO_x, CO, PM & air toxics
- Many fuel, hardware solutions are costly, some still untested, and many require major infrastructure changes
- Fleets affected include: urban transit vehicles, delivery & service fleets, construction and other off-road equipment
- U.S. market: ~50 billion gals. – vast, growing fast & highly segmented (on- vs. off-road, mobile vs. stationary, etc.)

Why E diesel®?

- Global environmental drivers forcing rapid change
- Diesel fuel quality issues at epicenter – fuel ethanol offers improvements
- World diesel demand growing faster than gasoline
- Renewable fuels standard in U.S. (elsewhere?)
expanding ethanol demand and supply
- Cost-effective, drop-in clean fuels needed for existing diesel-powered equipment

What is E diesel®?

- “Regular” diesel fuel (No. 1 or No. 2), EPA– or CARB–certified, all sulfur levels (ASTM D 975)
- Up to 15vol% fuel grade ethanol (ASTM D 4806)
- ~0.50 – 5.0vol% proprietary co–solvent creates stable ethanol–diesel microemulsion
- Cetane improver required
- All products can be rack blended (“splash” or in–line injection –– just like ethanol–gasoline blends)

What is E diesel®?

(continued)

Why Ethanol is an Attractive Diesel Oxygenate

Renewable, replacement for imported petroleum

No significant environmental side-effects

Widely proven as a gasoline oxygenate in world markets including U.S., Canada & Brazil

Supply & infrastructure already exists in key global markets (3 billion gals./yr. produced in U.S. alone)

Greenhouse gas reduction impacts (Argonne Labs)

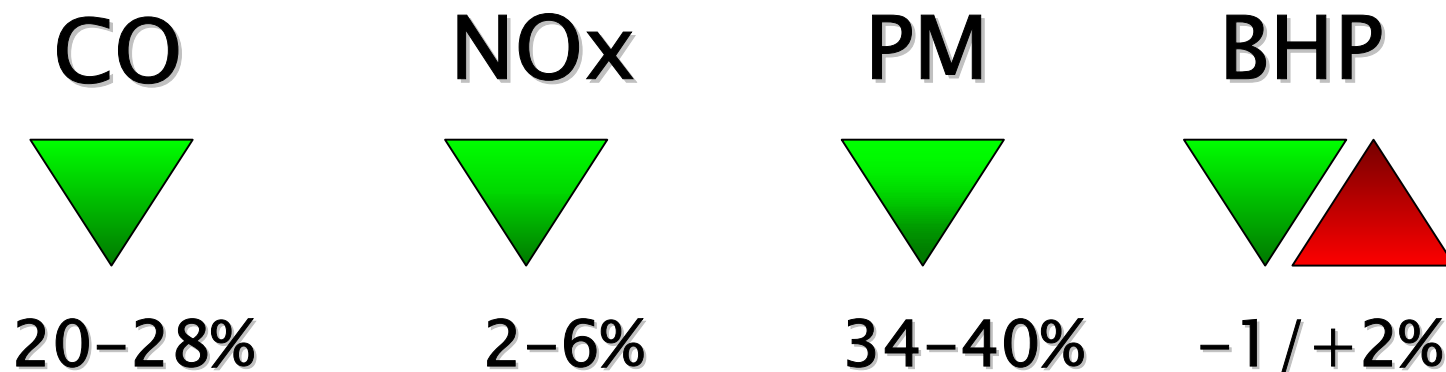
Performance Benefits of E diesel®

- Offers “Premium Diesel” characteristics
- Enhanced fuel lubricity (SLBOCLE, HFRR)
- Excellent cold temperature operability
- Good fuel detergency
- Good fuel stability (water & temperature tolerance)
- Good corrosion protection (NACE)
- Good thermal stability (Octel F-21)
- Outstanding fuel conductivity

“Typical” E diesel® Emissions Test Results (Heavy-Duty Engines)

Colo. School of Mines & Southwest Research Institute
(Nov. 1999 – Dec. 2002)

EPA No.2 Diesel vs. No.2 + 7.7vol% ethanol



EPA 13-mode Transient Cycle Engine Tests (1991 DDC Series 60)

Summary:

E diesel® Fleet Demo Test Results



Ease of logistics, distribution, and handling

- “Fill & Go” clean fuel solution
- Little or no infrastructure or engine changes
- Excellent cold weather operability
- Visible and measurable emission benefits

Good engine performance and driveability

- Fuel is fully fungible with regular diesel
- No reported mileage demerits (urban fleets)
- Economics better than other technologies

No capital investment required



E diesel® Technical Agenda: 2003

- “Ethanol–Blended Diesel Fuel Handbook” (Argonne National Laboratories) – undergoing peer review
- Uniform Safety and Handling procedures – Evaluation begun in 2001 /02 at Southwest Research Institute (SwRI)
- Greenhouse gas impact analysis by Argonne National Labs (Michael Wang, et al)
- Health effects testing required per Section 211(b) of the Clean Air Act – Tier 1 complete (two companies)
- John Deere cooperative test program (>\$2 million + 2 years) – SwRI testing now underway (3 engines)

E diesel® Technical Issues

- Managing flashpoint & flammability issues
- Determining materials compatibility & durability
- Establishing storage & handling requirements
- Setting ASTM/CGSB fuel specs acceptance
- Establishing “Fill & Go” recognition of fleet operators
- Completing EPA health effects testing, as required
- Identifying additional emissions benefits
- Complying with federal, state & local laws & regulations

E diesel® Technical Issues

Managing Flashpoint & Flammability

Industry–government research ongoing, including “failure mode effects analyses” (DOE/NREL, SwRI, DCCA, etc.)

Laboratory & Fields Results to Date:

- Fuel tank flame arrestors are quite effective
- Dry–lock refueling is proven safety practice
- Proper equipment grounding + high fuel conductivity limit ignition sources

Published results pending – more research planned

E diesel® Blend Safety Assured

Flame arrestor designs that prevent tank ignition demonstrated at SwRI:

- Worst case scenario testing
- 100% success at preventing ignition for the four tank designs tested



Reduces risks associated with using an ethanol–diesel fuel blend



FreedomCAR & DOE Biomass Program collaboration (State of Illinois co-funded)

Access report at (NREL/SR-540-34301):
<http://www.nrel.gov/docs/fy03osti/34301.pdf>



E diesel[®] Consortium: Organization

- Draft Consortium Charter approved Dec. 4, 2001
- Not-for-Profit Organization established under aegis of the Renewable Fuels Foundation
- Consortium began work in early 2002
- Significant technical & regulatory agenda (2002 – 04)
- Broad & active industry/government involvement
- Membership open to organizations supporting consortium's mission

E diesel® Consortium: Members

- Illinois “Core Group” (original *E-Diesel Task Force*)
- Major U.S. ethanol producers (ADM, Cargill, Williams)
- Additive Suppliers (Akzo Nobel, GE/Betz, Lubrizol, O₂Diesel, Inc., Pure Energy Corp.)
- Engine Manufacturers
- U.S. Dept. of Energy (including NREL, Argonne Nat’l. Lab)
- Renewable Fuels Association (U.S. and Canada)
- National Corn Growers Association (and state chapters)
- State agencies, local, public & private groups

Conclusions

- E diesel® tackling all technical & regulatory challenges
- Meaningful public & private support for E diesel® achieving results, reducing “due diligence” lead-time
- OEM skepticism remains significant – diverse industry cooperation needed
- Federal tax incentive issues must be addressed for full commercialization (action pending in Congress)
- Major competition from other new diesel(s) expected
- E diesel® Consortium leading effort to address all issues

For More Information, Contact:

The E diesel® Consortium Steering Committee

(partial list)

(see also http://www.afdc.doe.gov/altfuel/ediesel_general.html)

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